Printing

There area total of 124 commercial printing facilities in Washington, of which 83 are lithographic (SIC 2752), 2 are gravure (SIC 2754), and 39 are unclassified (SIC 2759). This report only includes sections on lithographic and screen printing.

Lithographic Printing

Description of Process

Ecology staff visited two lithographic facilities. Total hydrocarbon measurements were obtained at these facilities with a flame ionization detector during all the stages of press operation. In preparing for this report, Air Quality Program staff worked closely with Hazardous Waste Program and with Thurston County staff. Thurston county has spearheaded the hazardous material substitution specifically in lithographic facilities, and have inspected over 35 lithographers in their jurisdiction.

The category investigated includes only non-heated sheetfed, offset lithographic printers. Web-type offset presses, such as those of newspapers, were not investigated. Heated web-set presses have the potential for higher VOC emissions.

Offset lithography refers to the process of creating an image in paper from an exposed plate. The image is transferred or "offset" to a blanket cylinder after ink and fountain solution interact with the image plate. The blanket cylinder transfers the image onto sheetfed paper.

This process involves the use of inks, fountain solutions and cleaning solutions. Inks are oil based (petroleum or vegetable). Fountain solutions are water based and may contain up to 10% isopropyl alcohol plus small quantities of synthetic resins and buffers. Cleaning solutions are variable in composition including aliphatic and aromatic hydrocarbons, and less commonly chlorinated solvents such as methylene chloride.

The measurements conducted (2/2/94 and 3/8/94 reports) showed that the most significant emissions are the volatile components of blanket and roller washes and cleaners. These blanket washes may contain 20-40% toluene and/or xylene and other petroleum-derived compounds. During application, up to 1000 ppm total hydrocarbons (as methane) were measured. Measurements of the saturated vapor zone above ink and fountain solutions, were between 2 and 8 ppm (as methane). These levels remain the same during the ink roller application. During blanket and roller washing, the background press room levels rose and remained high (12-50 ppm).

Methods of Determining Emissions

The parameters that influence the press room emissions are: press operator practices, complexity of print job, order in which jobs are assigned to each press, number of presses, number of jobs per press, type of presses, and type of blanket and roller washes used.

Maximum one-hour calculated outdoor total VOC emissions (as methane) based on the highest measured values at a medium sized lithographic facility, estimated convective air exchange velocity rates, worst-case building configuration conducive to plume downwash, and the EPA model SCREEN, were 352 $\mu g/m^3$. For comparison, the acceptable source impact levels for xylene and toluene are 1500 $\mu g/m^3$ and 400 $\mu g/m^3$, respectively. Note that toluene and xylene are expected to be 20-40% of the total emissions. If the monitored facility represents the category well, this data supports the hypothesis that medium sized sheetfed offset lithographic facilities do not pose a recognized ambient air health threat. Note that this facility does not use chlorinated solvents. Certain chlorinated solvents such as methylene chloride have very low acceptable source impact levels, and thus may lead to increased ambient air carcinogenic risk.

The maximum estimated emissions from the above facility are approximately 900 pounds of VOC (as methane). A Hazardous Waste Program database is available that lists approximately 90% of the lithographic printing facilities in the state along with contact names, addresses and related information. Most of the facilities are smaller than the example used above, and it is expected their emissions would be lower.

Lithographic printer suppliers in the state were approached to obtain data on the type and total volume of products sold in the state. The suppliers were reluctant to provide such information.

The only method available to quantify the type and volume of cleaners used in the industry is to request the individual lithographic facilities to record their usage rate of blanket and roller washing products.

The press operators could be required to record the total volume of solvent and type used for each job. Aside from the benefit of collecting information, this practice could lead to reduced usage of cleaning solvents.

A second method to quantify emissions on a total VOC basis is contained in the EPA CTG document referenced below. This method utilizes an estimated rate of 0.04 gallons per unit hour based on a model plant. It is also assumed that 100% of the cleaning compound evaporates into the air. The rate is then used in the equation:

cleaning solv used = cleaning solution used rate X # units X hrs operation/yr
(gallons/year) (gallons per unit hour) (presses)

An industry representative (Eisenmann) believes that the EPA estimated usage rate is too high. In his facility, the estimated usage range actually ranges from 0.001 and 0.01 gallons/unit-hr.

Screen Printing

In screen printing, the ink passes through a porous screen of fine silk, Nylon, Dacron, polyester or stainless steel mesh to which a stencil has been applied. Printing is accomplished by applying ink to the screen and then forcing the ink through the stencil with a rubber or synthetic blade known as a squeegee. Inks are usually cured by applying heat, infrared (IR), or ultraviolet (UV) to the printed products. After the job is finished, the screens are cleaned of ink and stencil, then re-used.

Screen printing can print relatively heavy deposits of ink onto practically any type of surface, including fabric, plastics, metals, papers, and leather. Products printed include T-shirts, hats, printed circuit boards, signs and banners, nameplates, and containers of all kinds and shapes. The screen printing industry can generally be divided by product type into two groupings: textile printers, and flatwork printers.

Methods of Determining Emissions

VOC and HAP sources in screen printing come from the ink systems and screen cleaning solvents. A 1993 survey of Seattle area screen printer shops by King County's Metro Hazardous Waste Section's Screen Printer Project showed ink systems used as solvent based (61%), plastisol (45%), water-based (34%), and UV cured (14%).

Most of the solvent based inks are used by flatwork screen printers. These inks need to bond tightly to substrates like plastic, metal, or glass. Inks must be durable and dry quickly to avoid line spreading. Ink solvents can be xylols, toluene, ketones, and mineral spirits. Screen and tool clean up solvents are similar lacquer thinner type materials.

Textile printers use inks that are generally low in VOCs, so most emissions from these facilities will come from screen and equipment cleaning. Traditional cleaning solvents are xylene and toluene, but some printers are changing to lower VOC solvent alternatives and aqueous based products. Textile printers remove small ink contaminants from fabrics using a "blow out gun" that uses dry cleaning type solvents to dissolve and blow inking errors through the fabric on to a paper towel. Traditionally, the hottest solvent mix of 1,1,1 trichlorethylene, perchloroethylene, and methylene chloride that the printer can find is used. Mineral spirits can be used to clean some plastisol type inks.

Emissions from screen printers can only be done by a material balance based calculation. No emission factor will fit any two printers. They are all different. Major compounds to look for will be traditional ink bases and clean up solvents like toluene, xylene, MEK, other ketones, mineral spirits, and chlorinated solvents.

Material usage data combined with material composition data will be required to estimate emissions at individual screen printers. Inks and clean up solvents are the targeted materials. Production usage, purchasing records, MSD sheets, manufacturer's data sheets will be typical sources of this information.

A general method of estimation might be to estimate the usage of ten to twenty screen printers, including the largest printers. Then using a factor based on engineering judgment, apply these emission rates to the total number of screen printers registered in the state. This will probably not be accurate, but will give the best estimate possible without extensive data gathering.

One complication is that many screen printing operations are captive within another business, like a printed circuit manufacturer or airplane manufacturer. Other screen printers work out of their basement. Determination of the total number and size of screen printers in the state will be difficult.

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